

SEASONAL CHANGES IN THE ABUNDANCE OF CRYPTOSTIGMATA IN THE FOREST FLOOR OF AN OAK WOODLAND

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Between November, 1962 and March, 1964 a series of studies was made of the forest floor and its associated fauna and microflora in a broadleaved woodland (HARDING, 1966). This preliminary communication summarizes certain results relating to populations of mites in this site.

SITE AND METEOROLOGICAL DATA

Scotland Plantation is about one mile from Nottingham University School of Agriculture, and is dominated by oak (*Quercus* sp.) and beech (*Fagus sylvatica*) with a dense shrub layer of elder (*Sambucus nigra*). Herb and ground layers are virtually absent. The forest floor is on average *ca.* 5 cm deep, and consists of litter and F layers, without a distinct organic H layer. The F layer has a pH of 4.2, and merges gradually with the mineral soil, which is a well-drained sandy loam of pH 3.4.

Meteorological data, recorded at the School of Agriculture, are summarized in Table I. Compared with the long-term average, weather conditions during the sampling period and the preceding year were cool and dry. Mean soil temperatures were generally below average, and remained below freezing point between the end of December, 1962, and the beginning of the following March. Values around 15°C were recorded in July, while the second winter was relatively mild, soil temperatures rarely falling below freezing point.

The main period of leaf fall was between mid-October and the end of November.

TABLE I. Meteorological data, Sutton Bonington (November, 1962—March, 1964)

Month	Nov.	Dec.	Jan.	Feb.	March	Apr.	May	June
	1962		1963					
Mean soil temperature (4 inches depth; °C)	4.9	1.5	-1.1	-0.6	3.6	7.0	10.5	14.8
Total rainfall (inches)	1.0	1.5	0.8	0.4	2.7	1.7	0.8	2.4

Month	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
	1963						1964		
Mean soil temperature (4 inches depth; °C)	15.8	14.1	12.0	9.6	7.1	2.4	2.1	3.0	3.3
Total rainfall (inches)	1.7	2.7	2.2	1.1	3.8	0.4	0.6	0.5	2.7

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SAMPLING AND EXTRACTION

The forest floor was sampled 11 times from within a 10-metre square. Each sample consisted of 10 cores (= sampling units) of surface area 12.6 sq. cm and of depth corresponding to the thickness of the L and F layers. These cores were prepared in the laboratory from blocks removed from the site in rectangular frame samplers of surface area 150 sq. cm.

Micro-arthropods were recovered using Murphy's split-funnel extractor, litter and F material being treated separately.

ABUNDANCE OF ACARI AND CRYPTOSTIGMATA

Over 31 000 micro-arthropods were recovered, equivalent to a mean density of 21 5000 per sq. m. Eighty-three per cent of this total were mites, Cryptostigmata and Prostigmata constituting respectively 62 and 26 per cent of the total Acari. There were 43 species of Cryptostigmata, but only half-a-dozen species had dominance values greater than 10 per cent of the total number of adults. These included *Rhysotritia duplicata* (Grand-

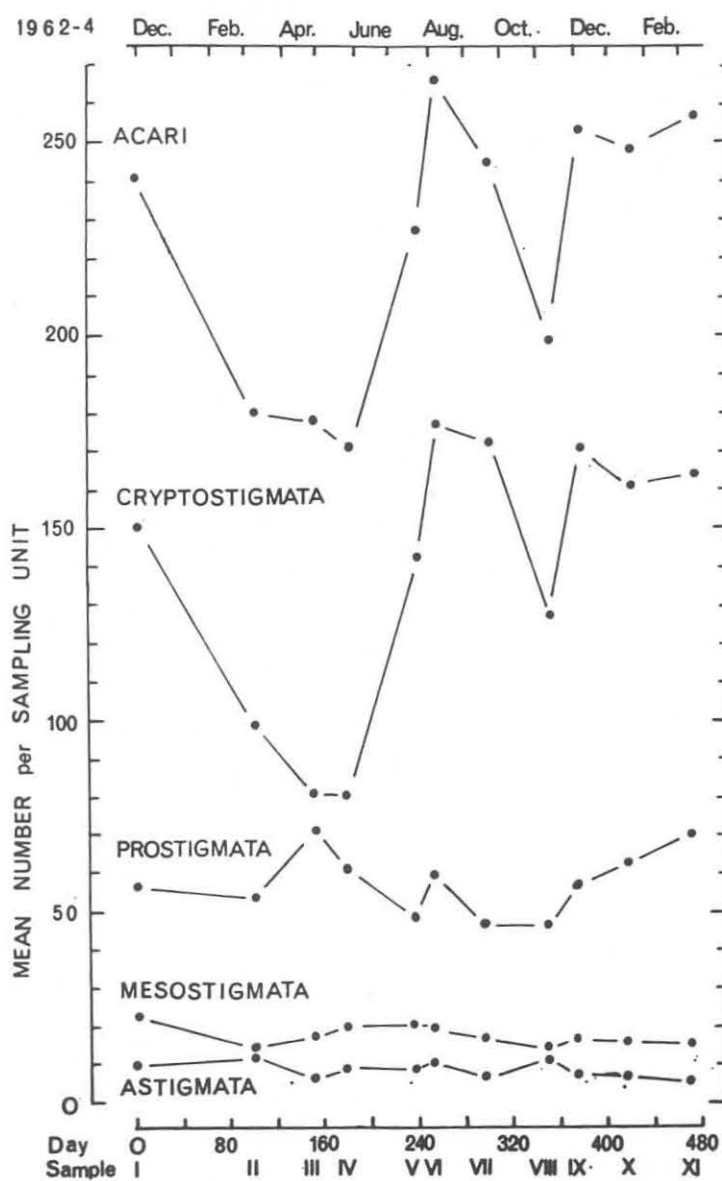


FIG. 1. Abundance of total Acari and four acarine orders in Scotland Plantation, 1962--1964 (ten sampling units per sample, each of surface area 12.6 sq. cm)

jean), *Suctobelba subtrigona* (Oudemans) and certain brachychthoniids, while 44 per cent of the adults were represented by *Tectocephus velatus* (Michael) s. lat., which was almost certainly a species complex of *T. velatus* and *T. sarekensis* Trägårdh. Immature oribatids made up 60 per cent of the total Cryptostigmata, 89 per cent of these being of *Tectocephus* and 8 per cent *Platynothrus peltifer* (C.L.K.).

Seasonal fluctuations in the numbers of total Acari and each of 4 acarine orders are shown in Fig. 1.

Immature Cryptostigmata had minimum densities in April and May, followed by higher values between July and March, whereas adult numbers fluctuated around two levels, the higher being between September and March.

The abundance of adults and immatures of *Tectocephus* decreased markedly between November and March. The immature decline continued in April and May, whereas there was a slight adult peak in April. Maximum populations of immatures were recorded

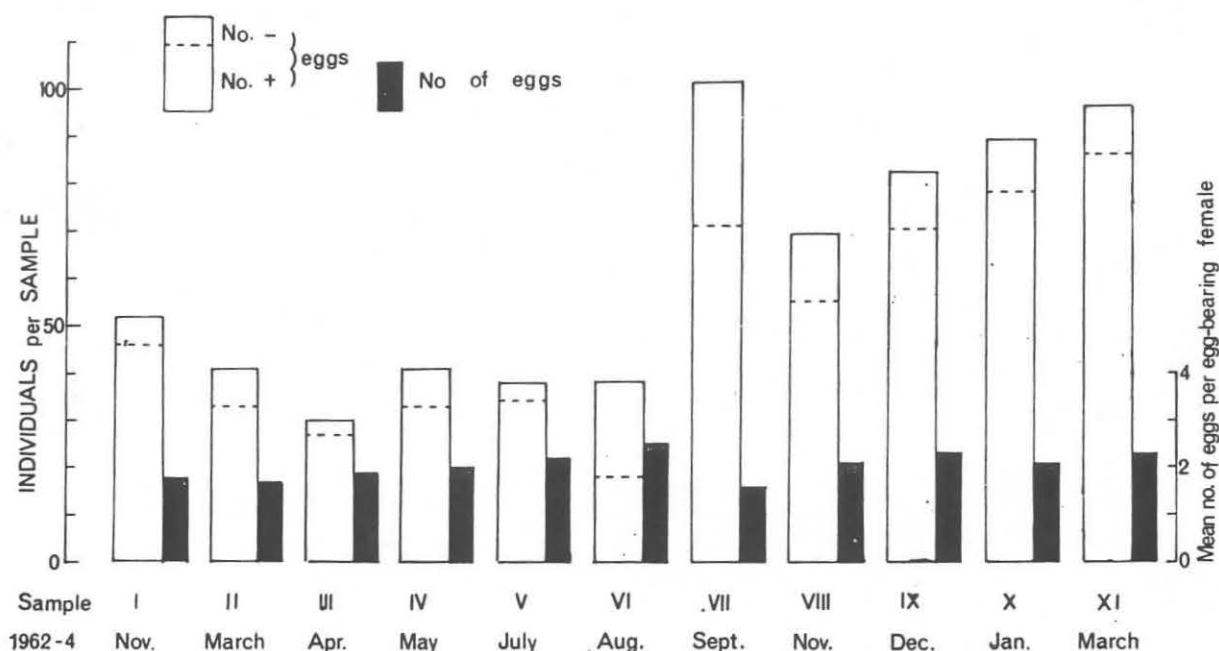


FIG. 2. *Rhysotritia duplicata* adults in Scotland Plantation, 1962—1964: Abundance, proportion with eggs and mean egg content

in August, a subsequent fall in September coinciding with a rise to the adult maximum. Although there was evidence of vertical migration of *Tectocephus* immatures during the second winter, numbers of adults and immatures remained relatively constant between December and March, in contrast to the situation at the beginning of 1963; this suggests that high mortality in this species was related to exceptionally low temperatures. The immatures have yet to be separated into instars, but comparison of these fluctuations with those reported by MURPHY and JALIL (1964) suggests that the immature peak in August may have been due largely to the presence of larvae. Increase in adult numbers in April and September, when immatures were declining, might have resulted from the moulting of tritonymphs; eggs laid by these young adults could perhaps have given rise to high immature densities in late summer and during the second winter.

Tectocephus was found in the deeper parts of the litter layer and throughout the F layer. *Suctobelba* and brachychthoniids showed a preference for the deeper parts of the F layer, but they also declined in abundance between November and March.

Seasonal fluctuations of *Platynothrus* will be described elsewhere. The main points for comparison with other species in this site are that there was no decrease in numbers during the first winter, and that the larval peak occurred in August.

In terms of percentage biomass the dominant adult oribatid in Scotland Plantation was the phthiracaroid *Rhyscritia duplicata*, with a value of 38 per cent. The number of adults recovered was about a quarter of the *Tectocepheus* total, corresponding to an average density of 5,000 per sq.m. Adults were particularly abundant in the deeper parts of the F layer, and were considerably larger than any other oribatid species at this depth (length = ca. 900 μ). Very few immatures were recovered, probably because of poor extraction of endophagous mites by a dry-funnel technique.

The 677 adults examined were all females, each containing from 0—5 large eggs (length = ca. 250 μ). The number of females with eggs and the mean number of eggs within these females are shown for each sample in Fig. 2. The proportion with eggs was between 81 and 93 per cent in all samples except those of August and September, when it fell to 50 and 64 per cent, respectively, while the mean number of eggs per egg-bearing female was just over 2. The proportion of lightly coloured adults in a sample ranged between 3 and 11 per cent, again with the exception of August and September, when these values were 42 and 45 per cent, respectively. Eggs were not seen in 76 per cent of these pale individuals, compared with 9 per cent of the dark mites, and it seems likely that most of these pale mites had recently moulted from tritonymphs. These data therefore suggest that most of the young adults appeared in August and September, and the marked rise in adult abundance in September supports the view of a mass ecdysis during the late summer. MORITZ (1963) also recorded a September maximum for *R. duplicata*, while high densities of *R. ardua* (C.L.K.) have been noted in July and September (VAN DER DRIFT, 1951) and September—October (LEBRUN, 1965).

Oviposition occurred throughout the year in the laboratory at the relatively high temperature of 15°C, while the presence of eggs in a high proportion of mites in the field at most times of the year suggests that there are no special oviposition seasons, although admittedly oviposition rates may vary. Small numbers of eggs were in fact found in the forest floor in June, September and January. If there is no peak oviposition period then there must be an alternative explanation for the late summer peak of adult emergence. Phenological data relating to the immatures are very incomplete, because of the small numbers extracted. However, tritonymphs were recovered from both March samples, and from all samples between April and November, and this instar was kept in culture for up to 3 months. It seems possible that in certain individuals the moult to the adult stage is retarded, perhaps by soil temperature, since the adult increase occurred shortly after the high temperatures in July.

The author has demonstrated the existence of parthenogenesis in *R. duplicata*, as was shown for *R. ardua* by LIONS (1967). In culture at 15°C an isolated mite, reared from a tritonymph, started to lay eggs in October, after 4 weeks as an adult. During the following year this mite laid about 2 eggs per week; the majority of these did not hatch, probably because of unsuitable conditions but possibly because they were non-viable. However, one egg was seen to hatch at the end of July.

SUMMER MAXIMA AMONG CRYPTOSTIGMATA

The late summer maxima of certain oribatids in Scotland Plantation are of some interest, since these are apparently rare in Europe (see LUXTON, 1967). In the case of *Platynothrus* and perhaps also *Tectocepheus* these maxima coincided with peak populations of larvae, which developed from eggs laid probably in the early summer, when rainfall and increasing soil temperatures may have stimulated the laying and development of eggs. The larval maxima occurred when soil temperatures were at their highest, but although the forest floor was relatively moist in July it was very dry in August and September.

Simultaneous studies of cellophane colonization in the forest floor suggested that abundant sources of microbial food were available to maintain large populations of microphytophagous immature oribatids during the late summer (HARDING, 1967). From September to March the diet of *Platynothrus* was supplemented by the presence of remains of elder leaflets in the forest floor.

Similar late summer maxima for larvae and total Cryptostigmata were noted in July—August in a Rothamsted oakwood (MADGE, 1965), and also by LUXTON (1967) in June and August, 1963, in a Welsh saltmarsh.

Temperature variations would be less extreme in the deeper parts of the F layer, inhabited by *Rhysotritia*, and suitable food in the form of woody remains, petioles or mid-ribs is always available. Oviposition seems to occur throughout the year, but there is some indication that the final moult may be synchronized by high soil temperatures.

SUMMARY

Population fluctuations among total Cryptostigmata in the forest floor of a Nottinghamshire woodland during 1962 — 4 were similar to those of the dominant species, *Tectocepheus velatus* (Mich.) s. lat., which declined sharply as a result of severe frost at the beginning of 1963. Parthenogenesis has been demonstrated in *Rhysotritia duplicata* (Grandjean), and seasonal variation in the proportion of egg-bearing adults is discussed.

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